PAT-NO: JP410320779A

DOCUMENT-IDENTIFIER: JP **10320779** A

TITLE: **RECORDER,** REPRODUCER AND OPTICAL RECORDING MEDIUM

PUBN-DATE: December 4, 1998

INVENTOR-INFORMATION:

NAME	COUNTRY
INASAWA, KATSUZUMI	
SUZUKI, TADAO	

1st

ASSIGNEE-INFORMATION:

NAME	COUNTRY
SONY CORP	N/A

APPL-NO: JP10034378

APPL-DATE: February 17, 1998

INT-CL (IPC): G11B007/00 , G11B007/007 , G11B019/04 , G11B020/10

ABSTRACT:

PROBLEM TO BE SOLVED: To prevent the duplicating of an optical recording medium by an unauthorized

copying by recording key data ciphering main data on an optical recording medium while modulating them in a pit width direction by changing the light quantity of a laser beam and, moreover, recording the main data ciphered by the key data on the medium while performing prescribed timing corrections of the laser beam.

SOLUTION: A master data KM is recorded on an optical recording medium while the pit width of it is modulated by intermittently changing the light quantity of a laser beam to be irradiated on an optical disk 23 with a light quantity modulation based on the master data KM. At this time, recorded data are made so as to be surely reproduced by correcting edge positions to be changed by the light quantity modulation as to a pit length direction while correcting irradiating timings of the laser beam. In accordance with this, in a reproducer 24 side, the master data KN is decoded by detecting the amplitude of a reproduced signal it a detecting part 25 and reproduced data are descramblingly processed by the master data KM in a decoder.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is applicable to the optical disk which records a video signal etc., and the recording apparatus and a regenerative apparatus, concerning a recording apparatus, a regenerative apparatus, and an optical recording medium. The duplicate of the optical recording medium by the illegal copy is prevented by this invention's modulating crosswise [pit] the key data which encipher the Maine data by changing the quantity of light of a laser beam, recording them on an optical recording medium, and amending and recording timing as reducing the jitter according the Maine data further enciphered with this key data to an intersymbol interference.
[0002]
[Description of the Prior Art] By carrying out an EFM (Eight-to-Fourteen Modulation) modulation to record data, to the predetermined fundamental period T, the pit train of periods 3T-11T is formed, and it is made as [record / audio data etc. / by this] in the compact disk which becomes with the former, for example, this kind, of optical information record medium.
[0003] By irradiating a laser beam at a compact disk and receiving return light, the compact disc player which plays this compact disk acquires the regenerative signal with which signal level changes according to the quantity of light of this return light, makes this regenerative signal binary with predetermined slice level, and generates a binary-ized signal. While driving a PLL circuit and generating a playback clock from this binary-ized signal furthermore, the sequential latch of the binary-ized signal is carried out with this playback clock, and the playback data which change periods 3T-11T corresponding to the pit train formed in the compact disk by this are generated.
[0004] A compact disc player decodes the playback data which carried out in this way and were generated by data processing corresponding to data processing at the time of record, and is made as [reproduce / the audio data recorded on the compact disk].
[0005] Thus, in the transmission system which transmits audio data etc. through the record medium of optical information, the anti-copying system as shown in drawing 18 R> 8 or drawing 19 in order to avoid an illegal copy effectively for example, is proposed.
[0006] That is, in the encoder 3 of disk work side 2, the anti-copying system 1 shown in drawing 18 carries out scramble processing of the data D1 with which record is presented with a master key KM, and records this data that carried out scramble processing on an optical disk 5. Moreover, in the decoder 7 of a regenerative apparatus 6, descrambling processing of the playback data reproduced from the optical disk is carried out with the common master key KM a disk work side, and this data that carried out descrambling processing is processed by the decoders 8, such as MPEG. Thereby, this anti-copying system 1 enciphers the data D1 with which record is presented using the common master key KM the playback side fixed in advance, and prevents an illegal copy.
[0007] Moreover, the anti-copying system 10 shown in drawing 19 enciphers the disk key KD of a proper to a master key MK and an optical disk 11, and enciphers data D1 by the title key KT of a proper to each work. That is, in an encoder 13, disk work side 12 carries out scramble processing of the disk

key KD with a master key KM, and records this disk key KD that carried out scramble processing on an optical disk 11. Moreover, in an encoder 14, scramble processing of the title key KT is carried out by the disk key KD which carried out scramble processing, and this title KT that carried out scramble processing is recorded on an optical disk 11.
[0008] Furthermore, in an encoder 15, disk work side 12 carries out scramble processing of the data D1 with which record is presented by the title KT which carried out scramble processing, and records them on an optical disk 11. Thereby, on the basis of a master key KM, disk work side 12 carries out scramble processing, and records data D1 on an optical disk 11 multiplex.
[0009] On the other hand, in a decoder 17, a regenerative apparatus 16 carries out descrambling processing of the disk key KD which carried out scramble processing with a master key KM, and decodes the disk key KD. Furthermore, descrambling processing of the title key KT which carried out scramble processing in the decoder 18 is carried out by the disk key KD, and descrambling processing of the data D1 is carried out by this disk key KD in the continuing decoder 19.
[0010] Thereby, this anti-copying system 10 is made as [prevent / consider the position of a disk maker and the implementer of a work and / an illegal copy].
[0011]
[Problem(s) to be Solved by the Invention] By the way, it is considered by the illegal copy for there to be two classes. One of them is the approach of making an optical disk refreshable with a regenerative apparatus based on this decode result, even if it is the pirate board by decoding a master key etc. Moreover, one which remains is the approach of copying physically the pit configuration formed in the optical disk of normal.
[0012] In an anti-copying system with a master key etc., about malpractice of this former, although it can respond by making decode of a master key etc. difficult etc., when a master key etc. is decoded, there is once a fault which cannot eliminate the pirate board at all. Moreover, there is a fault which cannot respond at all to the latter illegal copy.
[0013] This invention was made in consideration of the above point, and tends to propose the recording device, regenerative apparatus, and optical recording medium which can prevent an illegal copy.
[0014]
[Means for Solving the Problem] In order to solve this technical problem, the quantity of light of the light beam which applies to a recording apparatus in this invention, amends timing so that the jitter generated by the intersymbol interference at the time of playback may be reduced, and irradiates an optical recording medium is controlled, and while the Maine data enciphered with predetermined key data generate this record data, a light control means to control the quantity of light of a light beam according to this key data is controlled.
[0015] Moreover, the key data which applied to the regenerative apparatus, and restored to the Maine data enciphered by making a regenerative signal binary with predetermined slice level, and were detected from this regenerative signal cancel the Maine data encryption.
[0016] Moreover, it applies to the optical recording medium with which the data by which run length Huffman coding processing was carried out were recorded, key data are recorded by the width of face of a pit, a land, a mark, or a tooth space, and the Maine data enciphered by the die length and spacing of a pit and a land or a mark, and a tooth space by key data are recorded.
[0017] While the Maine data which controlled the quantity of light of the light beam which amends timing and irradiates an optical recording medium to reduce the jitter generated by the intersymbol interference, and were enciphered by predetermined key data generate this record data If a light control means to control the quantity of light of a light beam according to this key data is controlled, even when a pit or the width of face of a mark is different with control of the quantity of light according to key data, the Maine data can be recorded so that the Maine data can be reproduced certainly.
[0018] On the other hand, when a pit configuration is copied physically, it is difficult to copy correctly the difference of pit width of face etc., and the amended timing, and it becomes difficult for this to reproduce key data and the Maine data correctly. Therefore, it is a playback side and the medium by such copy can be eliminated. Moreover, it can respond about the illegal copy which analyzes key data

by changing suitably the key data recorded with pit width of face etc., and is performed.
[0019] Therefore, if the key data which applied to the regenerative apparatus, and restored to the Maine data enciphered by making a regenerative signal binary with predetermined slice level, and were detected from this regenerative signal cancel the Maine data encryption, from the optical recording medium which carried out in this way and was recorded, key data can be reproduced correctly and the Maine data encryption can be canceled.
[0020]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained in full detail, referring to a drawing suitably.
[0021] Drawing 1 is the block diagram showing the information-transmission path concerning the gestalt of operation of the 1st of this invention. In this information-transmission path 20, in the encoder 22 of disk work side 21, scramble processing of the data D1 to transmit is carried out with a master key KM, and this data that carried out scramble processing is recorded on an optical disk 23. At this time, this scramble-ized data is recorded with the pit length of an optical disk 23, and pit spacing in disk work side 21. In addition, the data D1 transmitted here are the video data in which the data compression was carried out by the format of MPEG (Moving Picture Experts Group), audio data, or audio data changed into the 1-bit digital signal by sigmadelta modulation.
[0022] Furthermore, the quantity of light of the laser beam which irradiates an optical disk 23 in the light modulation timing amendment circuit 28 is intermittently changed by the quantity of light modulation on the basis of a master key KM, this modulates pit width of face in disk work side 21, and a master key KM is recorded. The edge location which changes with quantity of light modulations is amended, and it enables it to reproduce the recorded data certainly about the pit die-length direction furthermore by amending the timing of a laser-beam exposure in disk work side 21 at this time.
[0023] Corresponding to this, by the regenerative-apparatus 24 side, a detecting element 25 detects the amplitude of a regenerative signal, it restores to a master key KM, and descrambling processing of the playback data is carried out with this master key KM in a decoder 26. With a regenerative apparatus 24, the data D1 in which descrambling processing was carried out by the decoder 27 are processed after that.

[0024] Drawing 2 is the block diagram showing the optical disk recording apparatus used by this disk work side 21. In disk work side 21, the disk original recording 31 is exposed with this optical disk recording apparatus 30, for example, the data D1 of an MPEG format are recorded. In work side of optical disk 21, after developing this disk original recording 31, by carrying out electrocasting processing, a mother disk is created and a stamper is created from this mother disk. Furthermore, by work side of optical disk 21, from the stamper which carried out in this way and was created, a disk-like substrate is created, the reflective film and a protective coat are formed in this disk-like substrate, and an optical disk is created.
[0025] That is, in this optical disk recording apparatus 30, a spindle motor 32 carries out revolution actuation of the disk original recording 31, and outputs the FG signal FG with which signal level starts for every predetermined angle of rotation from FG signal generator held at the pars basilaris ossis occipitalis. According to the exposure location of the disk original recording 31, the spindle servo circuit 33 drives a spindle motor 32 so that the frequency of this FG signal FG may turn into predetermined frequency, and thereby, it carries out revolution actuation of the disk original recording 31 according to the conditions of a constant linear velocity.
[0026] The laser 34 for record is constituted by gas laser etc., and injects the laser beam L for disk original recording exposure. An optical modulator 35 consists of electric sound optical elements, and switches and outputs the quantity of light of a laser beam L according to a control signal SC 1. Thereby, an optical modulator 35 modulates the quantity of light of a laser beam L according to a control signal SC 1.
[0027] An optical modulator 36 consists of electric sound optical elements, carries out on-off control of this laser beam L with a modulating signal S1, and injects it. A mirror 37 bends the optical path of this laser beam L, it injects towards the disk original recording 31, and an objective lens 38 condenses the

reflected light of this mirror 37 to the disk original recording 31. These mirrors 37 and an objective lens 38 carry out sequential migration, and, thereby, make the variation rate of the exposure location by the laser beam L carry out in the direction of a periphery of the disk original recording 31 in the direction of a periphery of the disk original recording 31 one by one according to the thread device which is not illustrated synchronizing with the revolution of the disk original recording 31.
[0028] Thereby, with this optical disk recording apparatus 30, where revolution actuation of the disk original recording 31 is carried out, a truck is spirally formed by migration of a mirror 37 and an objective lens 38, and a pit is formed in this truck one by one corresponding to a modulating signal S1. Furthermore, pit width of face is changed according to a control signal SC 1 at this time.
[0029] The data of a master key KM are set by the controller which is not illustrated, and a decoder 40 carries out scramble processing and outputs the data D1 with which sequential record is presented on the basis of the data of this master key KM. During the period which irradiates a laser beam, a modulation circuit 41 carries out a RLL (Run Length Limited) modulation, and outputs data streams, such as TOC outputted from a controller, to the field corresponding to the lead-in groove area of an optical disk. Furthermore, a modulation circuit 41 modulates and outputs the scramble data outputted from a decoder 40 to the field corresponding to the user area of an optical disk during the period which irradiates a laser beam following data streams, such as this TOC (Table Of Contents).
[0030] At this time, a modulation circuit 41 carries out interleave processing, after adding an error correcting code to these data according to a predetermined data-processing format. The data stream which carried out still in this way and was processed is changed into a serial data stream, and the modulating signal S2 with which signal level changes with the period of the integral multiple of a fundamental period T is outputted according to the bit array of this serial data stream.
[0031] The edge location amendment circuits 42A and 42B amend the timing of a modulating signal S2, and output modulating-signal S1A and S1B which come to be as a result of [that] timing amendment so that the change pattern of a modulating signal S2 may be detected and the intersymbol interference at the time of playback may be reduced according to this change pattern. Edge location amendment circuit 42B outputs modulating-signal S1B corresponding to the laser beam of the low (85 [%] quantity of lights) outputted from an optical modulator 35 to edge location amendment circuit 42A outputting modulating-signal S1A corresponding to the laser beam of the high level (100 [%] quantity of lights) outputted from an optical modulator 35 at this time.
[0032] The CRC circuit 43 adds and outputs an error correcting code to the data KM of a master key. At this time, the CRC circuit 43 outputs Data KM and the error correcting code of a master key with a period (hundreds - thousands pit period) long enough as compared with a pit formation period. Furthermore, Data KM and the error correcting code of a master key are repeatedly outputted to a sequential circulation target.
[0033] The PE modulation circuit (PE) 44 carries out PE (Phase Eecode) modulation of the output data of this CRC circuit 43, and outputs them by the serial data stream. During the period which is irradiating the laser beam to the field corresponding to lead-in groove area, to carrying out switch control of the signal level of a control signal SC 1 according to the output data D3 of the PE modulation circuit 44, as the level switch circuit 45 holds the quantity of light of a laser beam L to a high level, in other fields, it holds the signal level of a control signal SC 1 to constant value.
[0034] Thereby, the level switch circuit 45 modulates the quantity of light of a laser beam L according to a master key KM, and modulates the pit width of face formed in the disk original recording 31 by the modulation of this quantity of light. Thereby with the optical disk recording apparatus 30, it is made as [record / with pit width of face / the key data KM].
[0035] A data selector 46 carries out the selection output of modulating-signal S1A and S1B which are outputted from the edge location amendment circuits 42A and 42B at an optical modulator 36 according to a control signal SC 1. Thereby, during the period when the quantity of light of a laser beam L is set as the low by the level switch circuit 45, from modulating-signal S1A outputted from edge location amendment circuit 42A, a data selector 46 is switched to modulating-signal S1B outputted from edge location amendment circuit 42B, and carries out a selection output at an optical modulator 36. Thereby

with the optical disk recording device 30, it is made as [amend / change of the pit length which changes with the modulation of pit width of face / a switch of modulating-signal S1A and S1B].

[0036] Drawing 3 is the block diagram showing this edge location amendment circuit 42A. In addition, the duplicate explanation is omitted when edge location amendment circuit 42B comes to be the same as that of edge location amendment circuit 42A except that the amendment data stored in the rising edge amendment circuits 50A and 50B differ.

[0037] In edge location amendment circuit 42A, the level-conversion circuit 51 amends the signal level of a modulating signal S2 on the TTL (Transistor Transistor Logic) level which an output swing becomes by 5 [V], and is outputted. The PLL (Phase Locked Loop) circuit 52 generates and outputs Clock CK (drawing 4 (B)) from the modulating signal S3 (drawing 4 (A)) outputted from the level-conversion circuit 51, as shown in drawing 4 . In a modulating signal S2, when signal level changes with the period of the integral multiple of a fundamental period T, the PLL circuit 52 generates the clock CK from which signal level changes with the fundamental periods T which synchronized with this modulating signal S2.

[0038] As shown in drawing 5 , rising edge amendment circuit 50A connects to a serial 13 latch circuits 53A-53M which operate with Clock CK, and inputs the output signal S3 of the level-conversion circuit 51 into this series circuit. Thereby, rising edge amendment circuit 50A samples the output signal S3 of the level-conversion circuit 51 by the timing of Clock CK, and detects the change pattern of a modulating signal S2 from the continuous sampling result of 13 points. It can be judged as the change pattern of "0001111000001 [namely,]" with which the pit of die-length 4T continues following the tooth space between die-length 5T when a latch output is obtained. When the latch output of "0011111000001" is obtained similarly, it can be judged as the change pattern with which the pit of die-length 5T continues following the tooth space between die-length 5T.

[0039] The correction value table 54 is formed by the read-only memory which stored two or more amendment data, makes the address the latch output of latch circuits 53A-53M, and outputs the correction value data DF corresponding to the change pattern of a modulating signal S3. Monostable multivibrator (MM) 55 receives the input of a latch output from latch circuit 53G of 13 centers by which the series connection was carried out, and on the basis of the timing of the standup of this latch output, during a predetermined period (period shorter enough than periodic 3T), signal level starts and starts and outputs a pulse signal.

[0040] A delay circuit 56 has 12 steps of tap outputs, and the time delay difference between each tap is set as the resolution of timing amendment of the modulating signal in this edge location amendment circuit 42A. A delay circuit 56 is outputted from monostable multivibrator 55, starts, carries out sequential delay of the pulse signal, and outputs it from each tap. A selector 57 carries out the selection output of the tap output of a delay circuit 56 according to the correction value data DF, and carries out the selection output of the standup pulse signal SS (drawing 4 (D)) from which a time delay comes to change according to the correction value data DF by this.

[0041] Thereby, signal level starts corresponding to the standup of the signal level of a modulating signal S3, and rising edge amendment circuit 50A generates the rising edge signal SS with which the time delays delta r (3 3), delta r (4 3), delta r (3 4), and delta r (5 3) of each rising edge to the browning tone signal S3 and .... change according to the change pattern of a modulating signal S3.

[0042] In addition, in this drawing 4 , the table of the change pattern of a modulating signal S3 is carried out with the pit length p and the pit spacing b which made one period of Clock CK the unit, and deltar (p, b) shows the time delay over a rising edge. Therefore, in this drawing 4 (D), time delay deltar (4 3) described by the 2nd is a time delay in case the blank of three clocks is in front of the pit of die-length 4 clock. The correction value data DF corresponding to all the combination of these p and b will be stored in the correction value table 54 by this.

[0043] In carrying out, by [which write] irradiating a laser beam L according to a modulating signal S3, and forming a pit, rising edge amendment circuit 50A will detect the pattern of the pit formed in an optical disk, and will generate the rising edge signal SS with an optical disk according to this pattern about the range of periodic 12T which made the fundamental period T the unit.

[0044] Falling edge amendment circuit 50B is constituted identically to rising edge amendment circuit 50A except for that monostable multivibrator 55 operates on the basis of the falling edge of a latch output, and the contents of the correction value table 54 differing.
[0045] Thereby, signal level starts corresponding to falling of the signal level of a modulating signal S2, and falling edge amendment circuit 50B generates the time delays delta f (3 3), delta f (4 4), delta f (3 3), and delta f (5 4) of each rising edge to the browning tone signal S2, and the falling edge signal SR (drawing 4 (C)) with which .... changes according to the change pattern of a modulating signal S2. In addition, in this drawing 4 , deltaf (p, b) shows the time delay over a falling edge with the pit length p and the pit spacing b like the time delay over a rising edge.
[0046] About the range of periodic 12T which made the fundamental period T the unit in falling edge amendment circuit 50B in carrying out to write, the pattern of the pit formed in an optical disk is detected, the timing of the falling edge of the modulating signal S2 which becomes to the timing of exposure termination of a laser beam according to this pattern is amended, and it is made as [generate / the falling edge signal SR].
[0047] A flip-flop (F/F) 59 (drawing 3) compounds and outputs the rising edge signal SS generated in the edge amendment circuits 50A and 50B, and the falling edge signal SR. That is, a flip-flop 59 generates the modulating signal S5 with which signal level falls in the standup of the signal level of the falling edge signal SR, after it inputs the rising edge signal SS and the falling edge signal SR into the set terminal S and the reset terminal R, respectively and signal level starts in the standup of the signal level of the rising edge signal SS by this. An output swing amends the signal level of this modulating signal S5 that becomes on TTL level, and outputs the level reverse conversion circuit 60 by the original output swing.
[0048] Thereby, the timing of a rising edge and a falling edge is amended according to the pit of order, and the die length of a land, a modulating signal S2 is outputted, and the timing which irradiates a laser beam L to the disk original recording 31 corresponding to this is also amended corresponding to the pit of order, and the die length of a land.
[0049] In the optical disk recording apparatus 30, at the time of playback, this amends the location of the edge in front of each pit, and an after edge so that the jitter generated by the intersymbol interference may be reduced. Moreover, even when the edge location amendment circuits 42A and 42B corresponding to the quantity of light of the laser beam L for record bring down the quantity of light of a laser beam L, respectively, a regenerative signal is distinguished with a fixed threshold, and the location of the edge in front of each pit and an after edge is amended so that the data D1 recorded with pit length and pit spacing can be reproduced certainly.
[0050] Drawing 6 is process drawing with which explanation of generation of the correction value table 54 which does in this way and is used for timing amendment of an edge is presented. With the optical disk recording apparatus 30, even when pit length and former blank length change by setting up this correction value table 54 appropriately, a regenerative signal crosses predetermined slice level to the right timing which synchronized with Clock CK.
[0051] In addition, although the correction value table 54 is set as each rising edge amendment circuit 50A of the edge location amendment circuits 42A and 42B, and falling edge amendment circuit 50B, since all of a generation method are the same except that the conditions of generation differ, it explains rising edge amendment circuit 50A here.
[0052] In this process, a correction value table is set up based on the playback result of the optical disk which creates the disk original recording for assessment with the optical disk recording apparatus 30, and is created from this disk original recording.
[0053] In the disk original recording creation time for this assessment, the correction value table 54 for valuation bases is set to the optical disk recording apparatus 30 here. In a selector 57 (drawing 5), the correction value data DF are set up and the correction value table 54 of this valuation basis is formed so that the selection output of the center tap output of a delay circuit 56 may always be carried out. This exposes the disk original recording 31 according to the same conditions as the case where the direct optical modulator 36 is driven with a modulating signal S3, i.e., the same conditions as the usual optical

disk creation process, at this process.
[0054] At this process, after developing the disk original recording 31 which carried out in this way and was exposed, electrocasting processing is carried out, a mother disk is created, and a stamper 62 is created from this mother disk. An optical disk 63 is created still like [stamper / 62 / this] the usual optical disk creation process.
[0055] A regenerative apparatus 64 plays the optical disk 63 for assessment which carried out in this way and was created. At this time, a regenerative apparatus 64 is controlled by the computer 65, and outputs actuation to a digitizing oscilloscope 66 from the digital disposal circuit of built-in of the regenerative signal RF with which signal level changes according to the quantity of light of the return light obtained from a switch and an optical disk 63. In carrying out, by pit width of face changing with a switch of the quantity of light of a laser beam L, if a regenerative signal RF is observed with a digitizing oscilloscope 66, the amplitude of a regenerative signal will change with things in the part corresponding to a pit to write, and this optical disk 63 is observed. Incidentally as for drawing 7 and drawing 8 , it turns out that the signal wave form of the regenerative signal RF at the time of irradiating the quantity of light of a laser beam by the high level and the low, respectively is shown, and the amplitude increases from W2 to W1 according to the quantity of light of a laser beam.
[0056] Moreover, when the edge in front of a pit and the after edge are changing with change of pit width of face, with change of the amplitude, a big jitter will be observed and, as for a regenerative signal RF, asymmetry will also change a lot. Also in the part which furthermore formed the pit by the laser beam of the high level of user area etc., the jitter by the intersymbol interference from the pit of order is observed, and it becomes things.
[0057] A digitizing oscilloscope 66 is controlled by the computer 65, and outputs the digital signal which carries out analog-to-digital-conversion processing of this regenerative signal RF at a switch and a clock 20 times the sampling frequency of a channel, and is acquired as a result in actuation to a computer 65.
[0058] A computer 65 both carries out signal processing of the digital signal which controls actuation of a digitizing oscilloscope 66 and which is outputted from a digitizing oscilloscope 66, and, thereby, carries out sequential count of the correction value data DF. Furthermore, a computer 65 drives ROM writer 67, stores the calculated correction value data DF in a read-only memory one by one, and, thereby, forms the correction value table 54. At this process, an optical disk is eventually manufactured on this correction value table 54.
[0059] Drawing 9 is a flow chart which shows the procedure in this computer 65. In this procedure, a computer 65 moves from a step SP 1 to a step SP 2, and initializes jitter appearance result deltar (p, b) and the count n of jitter measurement (p, b) to a value 0. About the edge order which becomes for jitter appearance, for every combination of the pit length p and the pit spacing b, a computer 65 computes jitter appearance result deltar (p, b), and counts the count n of jitter measurement (p, b) here. For this reason, a computer 65 sets these jitter [all] appearance result deltar (p, b) and the count n of jitter measurement (p, b) to initial value in a step SP 2.
[0060] Then, a computer 65 generates the digital binary-ized signal which comes [that it is binary] -izing [a regenerative signal RF] by moving to a step SP 3 and comparing with predetermined slice level the digital signal outputted from a digitizing oscilloscope 66. In addition, in this processing, in the part with which more than slice level does not fill a value 1 and slice level, a computer 65 makes a digital signal binary so that it may become a value 0.
[0061] Then, a computer 65 moves to a step SP 4, and generates a playback clock from the binary-ized signal which becomes with this digital signal. A computer 65 carries out the simulation of the actuation of a PLL circuit by data processing on the basis of a binary-ized signal, and, thereby, generates a playback clock here.
[0062] Furthermore, in the continuing step SP 5, a computer 65 is the timing of each falling edge of the playback clock which carried out in this way and was generated, samples a binary-ized signal, and, thereby, decodes a modulating signal (this modulating signal decoded below is called a decode signal).
[0063] Then, a computer 65 moves to a step SP 6, detects the time difference e of an event to the event

of-falling of the playback clock which approached this edge most of the rising edge of a binary-ized signal, and, thereby, carries out time amount measurement of the jitter in this edge. Then, a computer 65 detects the former pit length p and the pit spacing b from a decode signal in a step SP 7 about the edge which carried out time amount measurement at a step SP 6.

[0064] The time difference e which the computer 65 detected in a step SP 6 in a step SP 8 to jitter appearance result deltar (p, b) corresponding to the former pit length p and the pit spacing b continuously is added, and only a value 1 increments the corresponding count n of jitter measurement (p, b). Then, a computer 65 will return to a step SP 5, if it moves to a step SP 9, it judges whether time amount measurement was completed about all rising edges and a negative result is obtained here.

[0065] Thereby, a computer 65 repeats step SP5-SP6-SP7-SP8-SP9-SP's5 procedure, and carries out accumulation of the jitter appearance result which appears in a regenerative signal RF of having carried out time amount measurement for every change pattern, and counts the number of addition. In addition, this change pattern is classified according to the period (it is the period of periodic 12T at the whole) of 6 before and after basing on a fundamental period T so that it may correspond to the number of stages of the latch circuits 53A-53M in rising edge amendment circuit 50A from the edge for jitter appearance sample.

[0066] Thus, about all edges, if time amount measurement of a jitter is completed, a computer 65 will move to a step SP 10 by obtaining an affirmation result in a step SP 9, and the jitter appearance result which appears in a regenerative signal RF here of having carried out time amount measurement for every change pattern will be average-ized. That is, in the jitter detected in a step SP 6, by being influenced of the noise, a computer 65 is carried out in this way, average-value-izes a jitter appearance result, and improves the accuracy of measurement of a jitter.

[0067] If it is carried out in this way and a jitter appearance result is average-ized, a computer 65 moves to a step SP 11 continuously, from this detection result, will generate the correction value data DF for every change pattern, respectively, and will output each correction value data DF to ROM writer 67. This correction value data DF sets the time delay difference between the taps in a delay circuit 56 with tau, and it is computed by performing data processing of a degree type here.

[0068]

[Equation 1]

$$Hr1\,(p,b) = \frac{-a \cdot \Delta r\,(p,b)}{\tau} + Hr0\,(p,b) \cdots\cdots (1)$$

[0069] In addition, Hr1 (p, b) is the tap of the delay circuit 56 chosen with the correction value data DF, and the case of a value 0 is a center tap here. Moreover, Hr0 (p, b) is the tap of the delay circuit 56 chosen with the correction value data DF which become with initial value, and Hr0 (p, b) will be set as the value 0 in the gestalt of this operation. Moreover, a is a constant. In the gestalt of this operation, a is made as [complete / certainly / correction value data] here, even if it is set as one or less values (for example, 0.7 etc.) and has the influence of a noise etc. by this.

[0070] Even when generation processing of the correction value data which were mentioned above, respectively the case where the quantity of light of a laser beam L is brought down on the basis of the signal level of the regenerative signal RF detected through a digitizing oscilloscope 66, and in the case of the usual quantity of light is performed and the quantity of light of a laser beam L is brought down by this, a computer 65 makes a regenerative signal RF binary with the usual slice level, and as it can generate a binary-ized signal by right timing, it generates correction-value data.

[0071] If a computer 65 stores in ROM writer 67 the correction value data DF which carried out in this way and were generated, it will move to a step SP 12 and will end this procedure. Then, a computer 65 performs same procedure about the falling edge of a digital binary-ized signal, and, thereby, completes the correction value table 54.

[0072] Drawing 10 is the block diagram showing the regenerative apparatus of the optical disk manufactured by doing in this way. This regenerative apparatus 70 carries out revolution actuation of the optical disk H with a spindle motor M, and irradiates the laser beam of wavelength 780 [nm] by optical

pickup P in this condition. Furthermore, a regenerative apparatus 70 receives the return light of this laser beam by optical pickup P, and generates the regenerative signal RF with which signal level changes according to the quantity of light of this return light.
[0073] After amplifying this regenerative signal RF, waveform equalization of the amplifying circuit 71 is carried out, and it is outputted. The binary-ized circuit 72 receives the regenerative signal RF outputted from this amplifying circuit 71, identifies the signal level of a regenerative signal RF with a predetermined threshold, and outputs the binary-ized signal S7. The PLL circuit 73 generates and outputs the playback clock (channel clock) CK on the basis of this binary-ized signal S7.
[0074] A regenerative signal RF is reproduced by the very small jitter here by the timing of a laser-beam exposure being amended at an optical disk work side according to the pattern of various pit formation, and coming to amend the timing of the edge in front of each pit, and an after edge. The amplitude will increase intermittently by having brought down the quantity of light of a laser beam intermittently, and furthermore, having modulated pit width of face in the lead-in groove area HR. Furthermore corresponding to buildup of the quantity of light of this laser beam, the timing of a laser-beam exposure is amended, and asymmetry equal to other parts is reproduced also in the part which brought down the quantity of light of a laser beam in this way by coming to amend the timing of the edge in front of each pit, and an after edge.
[0075] This sets in the binary-ized circuit 72, and the right timing corresponding to the fundamental period T at the time of record generates the binary-ized signal S7, and very few playback clocks CK of a jitter are generated in the PLL circuit 73, and it outputs.
[0076] A demodulator circuit 74 generates playback data by carrying out the sequential latch of the binary-ized signal on the basis of the playback clock CK. Furthermore, a demodulator circuit 74 restores to it and outputs this playback data. The servo circuit 75 detects the address of a laser-beam exposure location, and makes optical pickup P seek from this playback data based on this address detection result. In addition, the servo circuit 75 carries out spindle control of the spindle motor M on the basis of Clock CK further, and, thereby, carries out revolution actuation of the optical disk H according to the conditions of a constant linear velocity. Moreover, a predetermined seeking device is controlled by control of the system control circuit 76, and optical pickup P is made to seek.
[0077] After the ECC decoder 77 incorporates the playback data outputted from a demodulator circuit 74 and holds them to random access memory (RAM) 78, it carries out day interleave processing of this playback data by reading in predetermined sequence. Furthermore, the ECC decoder 77 carries out error correction processing, and outputs this playback data.
[0078] The master key detector 79 reproduces Data MK and the error correcting code of a master key from the amplitude of a regenerative signal RF. That is, as shown in drawing 11 , the master key detector 79 detects the pit beyond periodic 6T (pit of periodic 6T- period 11T) in the pit detector 81. The quantity of light of the laser at the time of disk original recording exposure is the pit correctly reflected in a regenerative signal, and the pit beyond periodic 6T is judged from MTF (Modulation TransferFunction) in playback optical system here.
[0079] The pit detector 81 inputs the binary-ized signal S7 into ten steps of latch circuits 80A-80J which carried out the series connection, and carries out the sequential transfer of this binary-ized signal with the playback clock CK. AND circuits 82A-82F will start the logical level of an output signal, if a predetermined input edge is set as a reversal input edge, and inputs the latch output of latch circuits 80A-80J and the latch output of latch circuits 80A-80J is set to a value 1 or a value 0 corresponding to periods 6T, 7T, and 8T and the pit of ...., respectively. OR circuit 83 receives the output signal of AND circuits 82A-82F, and outputs the OR signal. Thereby, the pit detector 81 detects the pit of periodic 6T-period 11T.
[0080] The master key detector 79 consists of an analog-to-digital-conversion circuit (A/D) 85 which carries out analog-to-digital-conversion processing of the regenerative signal RF, a delay circuit 86 delayed in the digital regenerative signal DRF outputted from the analog-to-digital-conversion circuit 95, and a pit detector 81.
[0081] A latch circuit 87 latches the digital regenerative signal DRF based on the detection result of the

pit detector 81, thereby, about the pit beyond periodic 6T, mostly, is the timing of the pit from which return light is obtained, and detects the amplitude of a regenerative signal RF from a center. the digital-to-analog conversion circuit 88 -- digital-to-analog transform processing of this digital regenerative signal DRF -- it carries out. The PE demodulator circuit 89 makes binary the output signal of the digital-to-analog conversion circuit 88, generates a binary-ized signal, and detects a clock from this binary-ized signal. Furthermore, the PE demodulator circuit 89 restores to the original data and the original error correcting code of a master key KM by processing a binary-ized signal on the basis of this clock. The PE demodulator circuit 89 carries out error correction processing, and outputs the data of the reproduced master key KM.

[0082] Thereby, at the time of playback initiation of optical disk H, the master key detector 79 reproduces the data of the master key KM repeatedly recorded on lead-in groove area, and outputs them to a decoder 91 (drawing 10).

[0083] A decoder 91 carries out descrambling processing of the playback data outputted from the ECC decoder 77 in user area on the basis of the data KM of this master key, and decodes the playback data which this enciphered. The continuing decoder 92 decodes and outputs the output data of a decoder 91 according to a format of MPEG.

[0084] In the above configuration, in the optical disk recording apparatus 30 (drawing 2 , drawing 3 , drawing 5), the correction value table 54 in the edge location amendment circuits 42A and 42B is set as initial value, the disk original recording 31 for assessment is created by the same conditions as the creation conditions of the conventional optical disk, and the optical disk 63 for assessment is created from this disk original recording 31 (drawing 6).

[0085] On-off control of the laser beam L is carried out by the modulating signal with which signal level changes with the period of the integral multiple of a fundamental period T, sequential exposure of the disk original recording 31 is carried out, and, thereby, as for the optical disk 63 for this assessment, input data D1 is recorded by pit length and pit spacing. Moreover, in lead-in groove area, based on the data of a master key KM, the quantity of light of a laser beam L is brought down, and, thereby, a master key KM is recorded by change of pit width of face. Furthermore, with change of this pit width of face, pit length changes and it is formed.

[0086] In the part in which the pit is formed of the quantity of light with the fixed regenerative signal acquired from the optical disk 63 for this assessment by this, a jitter will be observed by the intersymbol interference of an adjoining pit. Moreover, in addition to the intersymbol interference of an adjoining pit, about the part from which pit width of face changes, a big jitter will occur by change of pit length. Moreover, about the part from which this pit width of face changes, the amplitude of a regenerative signal will change a lot and asymmetry will also change violently.

[0087] Therefore, the timing which crosses slice level will change according to the pit of order and the change pattern of the modulating signal corresponding to the configuration of a land, and the laser-beam quantity of light at the time of exposure, and a big jitter will generate the regenerative signal acquired from this optical disk 63 in the playback clock generated from this regenerative signal.

[0088] After this optical disk 63 is played with a regenerative apparatus 64 and a regenerative signal RF is changed into a digital signal by the digitizing oscilloscope 66, a binary-ized signal, a decode signal, and a playback clock are generated by the computer 65. Furthermore, for every edge of a binary-ized signal, the pit and land of order are detected from a decode signal, the change pattern of a modulating signal is detected, and, as for an optical disk 63, time amount measurement of the amount of jitters of each edge to a playback clock is carried out for every change pattern.

[0089] By the case where the quantity of light of a laser beam is furthermore brought down, and the case where it holds to constant value, these time amount measurement result is average-value-ized for every change pattern, and the amount of jitters by each quantity of light of a laser beam is detected for every change pattern with the amount of jitters by the intersymbol interference. Data processing of (1) type on the basis of the time delay difference tau between taps of a delay circuit 56 (drawing 5) is performed with the amount of jitters which carried out the optical disk 63 in this way, and was detected, and the tap location of the delay circuit 56 which can negate this detected amount of jitters on the basis of the center

tap of a delay circuit 56 is detected. Furthermore, the data which pinpoint this detected tap location are stored in a read-only memory as correction value data DF, an optical disk 63 sets up the time delay difference tau between taps of a delay circuit 56 per jitter amendment by this, and the correction value table 54 is formed.
[0090] At this time, the correction value data DF corresponding to the laser-beam quantity of light of a high level are recorded on the correction value table 54 of edge location amendment circuit 42A, and the correction value data DF corresponding to the laser-beam quantity of light of a low are recorded on the correction value table 54 of edge location amendment circuit 42B.
[0091] Thus, if the correction value table 54 is formed, in the optical disk recording apparatus 30, data, such as TOC recorded on lead-in groove area, will be inputted into a modulation circuit 41, this modulation circuit 41 will receive predetermined data processing, and it will be changed into the modulating signal S2 with which a fundamental period T is made into a unit, and signal level changes. In edge location amendment circuit 42A (drawing 3), after signal level is changed into TTL level, as for this modulating signal S2, Clock CK is reproduced by the PLL circuit 52. Moreover, in rising edge amendment circuit 50A and falling edge amendment circuit 50B (drawing 5), a sequential latch is carried out by 13 steps of latch circuits 53A-53M, and a change pattern is detected, respectively.
[0092] Furthermore, in rising edge amendment circuit 50A, a modulating signal S2 is inputted into monostable multivibrator 55 from middle latch circuit 53G of these latch circuits 53A-53M, it is the timing of a rising edge and is the timing of a falling edge in falling edge amendment circuit 50B, and it carries out the trigger of the output of monostable multivibrator 55, respectively signal level starts to the timing of a rising edge and a falling edge, and starts, and generates a pulse signal and a falling pulse signal.
[0093] Respectively these standup pulse signal and a falling pulse signal make a unit the time delay tau used for calculation of the correction value data DF, sequential delay is carried out in the delay circuit 56 of rising edge amendment circuit 50A and falling edge amendment circuit 50B, and the tap output of this delay circuit 56 is outputted to a selector 57. On the other hand, the correction value data DF to which the change pattern of the modulating signal S2 detected by latch circuits 35A-35M is equivalent with access of the correction value table 54 which made the address the latch output of latch circuits 35A-35M are detected, and the contact of a selector 57 is switched with this correction value data DF.
[0094] From the selector 57 of rising edge amendment circuit 50A and falling edge amendment circuit 50B, the rising edge signal SS which amends the timing of the rising edge of a modulating signal S2 and a falling edge, respectively, and becomes, and the falling edge signal SR are outputted, and these rising edge signal SS and the falling edge signal SR (drawing 3) are compounded by the flip-flop 59 thereby, respectively so that the jitter at the time of irradiating the laser beam L detected with the optical disk 63 for assessment with a high level may be amended. Modulating-signal S1A which amends the timing of the edge of a modulating signal S2, and becomes is generated so that the output signal S5 of this flip-flop 59 may receive amendment of signal level by the level reverse conversion circuit 60 and the jitter at the time of irradiating the laser beam L which this detected with the optical disk 63 for assessment with a high level may furthermore be amended, namely, so that an intersymbol interference may be reduced.
[0095] Similarly, in edge location amendment circuit 42B, a change pattern is detected, the rising edge signal SS and the falling edge signal SR are generated by the correction value data DF corresponding to this change pattern, and, as for a modulating signal S2, these rising edge signal SS and the falling edge signal SR are compounded by the flip-flop 59. Thereby, modulating-signal S1B which amends the timing of the edge of a modulating signal S2, and becomes is generated so that change of the pit length in accordance with bringing down of the laser-beam quantity of light may be negated, and so that [so that a modulating signal S2 may amend the jitter at the time of irradiating the laser beam L detected with the optical disk 63 for assessment by the low in edge location amendment circuit 42B, namely,] an intersymbol interference may be reduced.
[0096] On the other hand, in the optical disk recording device 30, in the case of processing of this lead-in groove area, the data of the master key KM for encryption are inputted into the CRC circuit 43 from a predetermined controller, and an error correcting code is added to the data of this master key KM here.

After the data and the error correcting code of this master key KM are furthermore changed into a serial data stream in the PE modulation circuit 44, PR modulation is carried out and that modulation data D3 is inputted into the level switch circuit 45.
[0097] Furthermore according to this modulation data D3, the signal level of a control signal SC 1 is switched by the level switch circuit 45, and, thereby, the quantity of light of a laser beam L is switched to a low from a high level according to the modulation data D3. Thereby, in the disk original recording 31, in the field corresponding to the lead-in groove area of an optical disk, it is exposed so that pit width of face may change according to the data of a master key KM.
[0098] During the period which sets the quantity of light of a laser beam L as a low, in a data selector 46, modulating-signal S1B outputted from edge location amendment circuit 42B is chosen, and the selection output of the modulating-signal S1A outputted from edge location amendment circuit 42A is carried out in periods other than this with the optical disk recording apparatus 30 at this time.
[0099] Thereby, it is exposed so that pit width of face may change in the field corresponding to the lead-in groove area of an optical disk in the disk original recording 31 according to the data of a master key KM, and the timing of exposure is amended so that the change of pit length accompanying change of this pit width of face may be prevented further. Moreover, the timing of exposure is amended so that the intersymbol interference by the adjoining pit may be reduced.
[0100] Thus, exposure of lead-in groove area exposes the user area where the disk original recording 31 continues. At this time, the sequential input of the video data D1 based on MPEG is carried out with the optical disk recording apparatus 30 at a decoder 40. This input data D1 is continuously changed into a modulating signal S2 by the modulation circuit 41, after scramble processing is carried out with the data of a master key KM and being enciphered in a decoder 40, and modulating-signal S1A and S1B of an edge of this modulating signal S2 which come to amend timing are generated like the case where TOC data etc. are recorded on lead-in groove area.
[0101] Furthermore, this input data D1 is in the condition that the quantity of light of a laser beam L was held by the level switch circuit 45 at a high level, modulating-signal S1A is chosen by the data selector 46, and when the disk original recording 31 is exposed one by one by this modulating-signal S1A (S1), it is recorded on the disk original recording 31. Thereby, with the optical disk recording apparatus 30, as reducing the intersymbol interference by the adjoining pit, pit length is amended and the data D1 enciphered on the basis of the master key KM are recorded by fixed pit width of face.
[0102] From the disk original recording 31 exposed by doing in this way in this way, an optical disk is produced and this optical disk H is reproduced with a regenerative apparatus 70 (drawing 10). By this, the video data D1 by which encryption processing of the optical disk H was carried out with the master key KM will be recorded on the user area HV, and the data of this master key KM will be recorded on the lead-in groove area HR. According to the putter by combination with an adjoining pit, the location of a before edge and an after edge will be amended, and it will be recorded by pit length and pit spacing so that these data may furthermore reduce the intersymbol interference from an adjoining pit. The location of a before edge and an after edge will be amended so that it may be recorded on the lead-in groove area HR by change of pit width of face and change of the pit length by change of pit width of face may furthermore be negated in a master key KM in the pit which switched this pit width of face further.
[0103] When imprinting a pit configuration more nearly physically than such an optical disk and copying an optical disk, a physical change of a pit configuration cannot be avoided and it becomes difficult the edge location which this amended in this way, and to reproduce change of pit width of face to accuracy further. Thereby, the optical disk by this kind of copy becomes playback difficulty in a regenerative apparatus.
[0104] That is, in a regenerative apparatus 70, if loaded with optical disk H, optical pickup P will move to the most inner circumference of optical disk H, and the regenerative signal RF with which signal level changes according to the quantity of light of return light from the lead-in groove area HR of optical disk H will be detected.
[0105] In the binary-ized circuit 72, this regenerative signal RF is sliced by predetermined slice level, and is changed into the binary-ized signal S7. Furthermore, from this binary-ized signal S7, the playback

clock CK is generated in the PLL circuit 73, in a demodulator circuit 74, the sequential latch of the binary-ized signal S7 is carried out with this playback clock CK, and playback data are generated. After this playback data furthermore gets over in a demodulator circuit 74, it sets to the continuing ECC decoder 77, and it is day-interleave-processed and error correction processing is carried out.
[0106] In this the processing of a series of, as shown in drawing 12 , when playing the optical disk to which the quantity of light was only switched and pit width of face was changed, the slice level SL1 and SL2 for making a regenerative signal RF binary so that signal level may change with the timing corresponding to a fundamental period T will change according to the quantity of light at the time of exposure.
[0107] However, in optical disk H concerning the gestalt of this operation, as shown in drawing 13 , a regenerative signal RF can be made binary with the fixed slice level SL, and right timing can generate a binary-ized signal by amending the location of a before edge and an after edge, so that change of the pit length by change of pit width of face may be negated. That is, a binary-ized signal is generable with single slice level so that the jitter of the playback clock CK accompanying a switch of the quantity of light can be avoided effectively. Furthermore, the jitter by the intersymbol interference can also be reduced by amending the location of an edge so that this may be reduced also about an intersymbol interference.
[0108] in addition, in drawing 12 , when the regenerative signal from the pit formed with the quantity of light of 85 [%] is sliced with the slice level SL 1 to the pit formed with the quantity of light of 100 [%], like the regenerative signal of periodic 3T When the amplitude of a regenerative signal is small, it turns out that a bit error occurs to the playback data which a jitter not only increases by this, but stop crossing the signal level [itself] slice level of a binary-ized signal, and it generates from this binary-ized signal.
[0109] On the other hand, since it is difficult the amended edge location and to reproduce change of pit width of face to accuracy further when based on a copy, the signal level of the binary-ized signal S7 will not change with right timing, a jitter will occur on the part playback clock CK, and a bit error with an error correction still more difficult for playback data occurs. Thereby with a regenerative apparatus 70, reproducing becomes difficult about the optical disk by this kind of copy.
[0110] The binary-ized signal S7 to write and which was generated by doing in this way in carrying out is inputted into the master key detector 79 with a regenerative signal RF and the playback clock CK, and the master key KM recorded by change of pit width of face here is reproduced. That is, in the master key detector 79, the signal level of ten samples which the sequential latch of the binary-ized signal S7 is carried out with the playback clock CK, and continue is detected, and the pit beyond periodic 6T is detected by the logical operation of these 10 sample in AND circuits 82A-82F.
[0111] After the signal level of a regenerative signal RF is detected by the latch circuit 87 to the timing of the pit beyond periodic 6T furthermore detected, in the PE demodulator circuit 89, the data of a master key KM get over by processing the detected signal level. Thereby, with a regenerative apparatus 70, in a decoder 91, sequential descrambling processing of the playback data outputted from the ECC decoder 77 is carried out, and the original data D1 get over with the data of this reproduced master key KM.
[0112] According to control of pit width of face being difficult about the optical disk of the copy which records the data D1 reproduced by doing in this way at this time, and is generated, it is difficult to reproduce the data of a master key KM, and, thereby, it can make it playback difficulty also with such a copy. Moreover, the optical disk by the copy can be eliminated also about such a case by analyzing a master key KM, and changing this master key KM if needed, even if it sets up the optical disk by the copy which is not recording the master key KM refreshable.
[0113] According to the above configuration, the input data D1 which becomes by the Maine data is enciphered with a master key KM, while recording, by [which amend timing and is recorded with pit length and pit spacing so that the jitter by the intersymbol interference may be reduced] recording this master key with pit width of face, it can be set as playback difficulty by the regenerative-apparatus side, and this kind of illegal copy can be eliminated about an illegal copy. Moreover, even when desired data are recorded on high density, these data are certainly reproducible, and a pan can set an illegal copy as

playback difficulty by the regenerative-apparatus side, and can eliminate this kind of illegal copy.
[0114] The master key which detected change of pit width of face certainly, and was furthermore recorded with pit width of face about the pit beyond periodic 6T by having detected selectively the signal level of the regenerative signal accompanying change of pit width of face is certainly reproducible.
[0115] (2) Gestalt drawing 14 of the 2nd operation is the block diagram showing the information-transmission path concerning the gestalt of operation of the 2nd of this invention by comparison with drawing 1 . With the gestalt of this operation, the disk key KD and the title key KT are enciphered hierarchical with a master key KM, and it records on an optical disk 101, and a master key KM is recorded like the gestalt of the 1st operation.
[0116] By enciphering the disk key KD and the title key KT hierarchical with a master key KM, and recording on an optical disk 101, and recording a master key KM like the gestalt of the 1st operation, in addition to the effectiveness of the gestalt of the 1st operation, the position of a disk maker and the implementer of a work can be considered and, according to the configuration shown in this drawing 14 , an illegal copy can be eliminated.
[0117] (3) Gestalt drawing 15 of the 3rd operation is the decomposition perspective view showing the optical disk concerning the gestalt of the 3rd operation. As shown in drawing 16 , after forming the predetermined reflective film 103A and 103B in the disk substrates 102A and 102B, this optical disk 102 carries out the laminating of these disk substrates 102A and 102B, it adheres and a protective coat 104 is formed.
[0118] At this time, an optical disk 102 is formed with the reflective film with which reflective film 103A adhering to lower layer disk substrate 102A has wavelength selectivity, when a protective coat 104 is made into an upper layer side. That is, to the laser beam L1 of the wavelength 650 [nm] which comes to make the information recording surface by this reflective film 103A into a processing object, this reflective film 103A shows a high reflection factor, and is made as [show / light transmission nature] to the laser beam L2 of the wavelength 780 [nm] which comes to make the information recording surface by reflective film 103B of this upper layer into a processing object.
[0119] Thereby, an optical disk 102 irradiates wavelength 650 [nm] and the laser beams L1 and L2 of 780 [nm] from the lower layer disk substrate 102A side, respectively, and is made as [receive / the return light from each reflective film 103A and 102B]. It is the wavelength as the regenerative apparatus 70 of optical disk H concerning the gestalt of the 1st operation with the same laser beam L2 of coming [780] wavelength for reflective film 103B of this upper layer in carrying out [nm] to write.
[0120] Injection molding of the transparence resin, such as a polycarbonate, is carried out, as compared with a common optical disk, board thickness is formed in one half, and desired key data are recorded by change of pit width of face like the case of the optical disk which requires for the gestalt of the 1st operation La Stampa used for this shaping, respectively, and each disk substrates 102A and 102B are made as [form / the edge of each pit / amend and].
[0121] Among these, of the same format as the gestalt of the 1st operation of a ****, disk substrate 102B by the side of the upper layer enciphers the video data based on MPEG with a master key KM, and is recorded and formed with this master key KM. Thereby, it is made and this optical disk 102 is made as [maintain / optical disk H and compatibility which were mentioned above] so that it may reproduce with the above-mentioned regenerative apparatus 70 and the video data recorded on disk substrate 102B by the side of the upper layer can be reproduced.
[0122] On the other hand, disk substrate 102A by the side of a lower layer carries out coding processing of the video signal before coding of the video data recorded on disk substrate 102B by the side of this upper layer by high-definition coding processing as compared with the disk substrate 102B side, and the video data obtained as a result is recorded on high density as compared with the disk substrate 102B side. Furthermore, at this time, disk substrate 102A by the side of a lower layer is replaced with a master key KM, the 2nd master key KMA is recorded on lead-in groove area by change of pit width of face, and as shown in drawing 17 , based on this master key KM and 2nd master key KMA, a video data D3 is enciphered to the master key KM recorded on disk substrate 102B by the side of the upper layer.

[0123] That is, this drawing 17 shows the encoder of a video data D3, and presets predetermined key data to 15 steps of shift registers 111 in this encoder 110. The key data which chose the key data set as this shift register 111 here from two or more kinds of key data set up in advance according to data of 4 bits of low order of a master key KM are assigned. A shift register 111 carries out the sequential transfer of this key data synchronizing with the bit clock of a video data D3, and outputs it to the adder circuit 112 of IKUSUKURUSHIBUOA circuitry from the last stage. Moreover, the output of this last stage and the register output following this last stage are outputted to the adder circuit 113 of IKUSUKURUSHIBUOA circuitry, and the output of this adder circuit 113 is inputted into the register of a head stage. Thereby, it is made as [set / a data value] so that it is made as [output / to an adder circuit 112 / making an order change of the key data of a preset value in a shift register 111], and it may not converge on constant value in two or more kinds of key data set up in advance, even if it carries out patrol addition in this way.
[0124] On the other hand, a shift register 114 carries out the series connection of r steps of registers, is formed, carries out the sequential transfer of the data held synchronizing with the bit clock of a video data D3, and outputs them to the adder circuit 112 of IKUSUKURUSHIBUOA circuitry from the last stage. Moreover, the output of this last stage and the register output following this last stage are outputted to the adder circuit 115 of IKUSUKURUSHIBUOA circuitry, and the output of this adder circuit 115 is inputted into the register of a head stage. Thereby, it is made as [output / to an adder circuit 112], making an order change of the data by which presetting was carried out in the shift register 111.
[0125] Furthermore, the shift register 114 is made as [set / n bits of the 2nd master key KMA / the m-bit data of a master key KM are set as m steps of registers as a preset value among r steps of registers, and / to n sets of the registers which remain / as a preset value]. Thereby with this optical disk 102, it is made as [detect / the key data for decryption] with the configuration which only created reflective film 103A to lower layer disk substrate 102A.
[0126] An adder circuit 112 outputs the output data of shift registers 111 and 114 to the adder circuit 116 to write and which adds and continues in carrying out. An adder circuit 116 is constituted by the IKUSUKURUSHIBUOA circuit, inputs a video data D3 in a serial data format, and it is added with the output data of an adder circuit 112, and it outputs it. An encoder 110 changes and outputs these output data to parallel data, in an optical disk 102, after interleave processing of these output data is carried out with an error correcting code, it is changed into a modulating signal and a pit is formed one by one.
[0127] On the other hand, in the regenerative apparatus of dedication of this optical disk 102, if loaded with an optical disk 102, the laser beam corresponding to the reflective film 103A and 103B will be irradiated, respectively, and the master keys KM and KMA recorded by change of pit width of face from that return light will be reproduced. The key data based on m bits of the key data furthermore specified as the encoder of drawing 17 and the decoder of the same configuration with these reproduced master keys KM and KMA by 4 bits of low order of a master key KM, respectively and a master key KM and n bits of a master key KMA are set.
[0128] Furthermore, in user area, from reflective film 103A, return light is received, a regenerative signal is acquired, this regenerative signal is processed, and playback data are generated. Furthermore, a day interleave and after carrying out error correction processing, this decoder cancels encryption for this playback data.
[0129] According to the configuration which the gestalt of this 3rd operation requires, with one kind of optical disk, a video raw material can be offered by different format, and when a copy is created with a single disk substrate about disk substrate 102A which recorded the video raw material by coding processing of this time high definition, this copy can be eliminated effectively.
[0130] (4) it is the gestalt of other operations -- in the gestalt of above-mentioned operation, although the case where it enciphered with master keys KM and KMA to the data recorded on the reflective film 103A and 103B of an optical disk, respectively was described This invention may encode the data recorded on reflective film 103B with the master key recorded for example, not only on this but on reflective film 103A, and may encipher as this the data recorded on reflective film 103A with the master

key recorded on reverse at reflective film 103B.
[0131] Moreover, in the gestalt of above-mentioned operation, in each disk substrate, although the case where the master key of 1 was recorded with pit width of face was described, this invention may record not only this but two or more kinds of key data, and may use them selectively. In addition, the key data of these plurality may be distributed to a disk key, a title key, etc. in this case. furthermore, data processing of various key data of these plurality is boiled and carried out to a regenerative-apparatus side, and you may enable it to decode the data which enciphered the data obtained as a result as key data

[0132] Although the case where the key data for decryption were recorded on lead-in groove area was furthermore described in the gestalt of above-mentioned operation, this invention may be recorded not only on this but on user area etc.
[0133] Moreover, although the case where the data which referred to the master key which used directly the key data for decryption recorded on lead-in groove area in the gestalt of above-mentioned operation, or was recorded on lead-in groove area, and were enciphered were decoded was described this invention -- for example, not only this but pit width of face -- or when it specifies two or more kinds of key data recorded with pit length and spacing with the data recorded with pit width of face, it can apply widely.
[0134] Furthermore, although the case where switched the quantity of light of a laser beam in the gestalt of above-mentioned operation in two steps, and pit width of face was modulated was described, when change of pit width of face can fully be practically identified in addition to this, this invention may switch the quantity of light of a laser beam on a multistage story, and may modulate pit width of face.
[0135] Moreover, although change of pit width of face only described the case where a master key was repeatedly recorded on lead-in groove area, this invention may be made to perform record of the master key by change of not only this but this pit width of face etc. in the gestalt of above-mentioned operation only about a predetermined field according to a laser-beam exposure location. To the timing which synchronized with the revolution of an optical disk in this case, if the master key by change of pit width of face etc. is recorded intermittently, in the reflector of an optical disk, the pattern of the shape of a bar code which spreads in a radial can be formed, and it can judge whether it is an illegal copy by the existence of this pattern. Moreover, graphic form patterns, such as a manufacture name, can also be formed in a reflector.
[0136] Although the case where the key data for decryption were only recorded by the modulation of pit width of face was furthermore described in the gestalt of above-mentioned operation, this invention combines data, such as a destination of an unnecessary optical disk, and you may make it record them not only for this but for a user.
[0137] Moreover, in the gestalt of above-mentioned operation, although the case where an optical disk was created using directly the correction value table created with the optical disk for assessment was described, this invention may create the optical disk for assessment anew using the correction value table created not only with this but with the optical disk for assessment, and may correct a correction value table with this optical disk for assessment created anew. Thus, if a repeat correction value table is corrected, a jitter can be reduced that much certainly.
[0138] Moreover, in the gestalt of above-mentioned operation, although the case where sampled a modulating signal 13 times and a change pattern was detected was described, this invention may increase the number of samplings not only this but if needed, and, thereby, can respond to a long recording information pattern.
[0139] Furthermore, in the gestalt of above-mentioned operation, although the case where measured the amount of jitters by time amount measurement of the binary-ized signal on the basis of a basic clock, and correction value data were generated from this measurement result was described When not only this but practically sufficient precision can be secured, this invention may be replaced with measurement of the amount of jitters by this time amount measurement, and may generate correction value data by signal level detection of the regenerative signal on the basis of a basic clock. In addition, from the signal level of the regenerative signal detected in this case, the error voltage to slice level will be calculated and correction value data will be computed with this error voltage and the transient response property of

a regenerative signal.
[0140] Moreover, in the gestalt of above-mentioned operation, although the case where the timing of a modulating signal was amended according to the table-ized correction value data was described, when not only this but practically sufficient precision can be secured, this invention may be replaced with the correction value data detected beforehand, may compute correction value data by data processing, and, thereby, may amend the timing of a modulating signal.
[0141] Furthermore, although the case where correction value data were computed with the optical disk for assessment in the gestalt of above-mentioned operation was described, this invention may compute correction value data based on the so-called trial [in / it tries and writes and / a field] writing result, when applying to the optical disk recording device of for example, not only this but a write-once mold.
[0142] Furthermore, although the case where the video data of an MPEG method was recorded in the gestalt of above-mentioned operation was described, this invention may record the digital audio signal quantized by not only this but disk substrate 102A by 16 bits, and may record the 1-bit digital audio signal which sampled with the sampling frequency 2.8224 [MHz] (44.1[kHz] x64 time), and was quantized on disk substrate 102B.
[0143] Moreover, in the gestalt of above-mentioned operation, although the case where this invention was applied to an optical disk was described, this invention is widely applicable to the optical disk recording apparatus which records various data not only by this but by the pit, and the optical disk recording apparatus which records various data by the mark with the application of the technique of heat magnetic recording further. It is widely applicable also to the optical disk recording device incidentally made as [carry out / according to a difference of the transient response property of a regenerative signal / multiple-value record of the various data].
[0144]
[Effect of the Invention] According to this invention, the duplicate of the optical recording medium by the illegal copy is prevented as mentioned above by modulating crosswise [pit] the key data which encipher the Maine data by changing the quantity of light of a laser beam, recording on an optical recording medium, and amending and recording timing as reducing the jitter according the Maine data further enciphered with this key data to an intersymbol interference.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the information-transmission path in the optical disk concerning the gestalt of operation of the 1st of this invention.
[Drawing 2] It is the block diagram showing the optical disk recording apparatus used for the disk work side of drawing 1 .
[Drawing 3] It is the block diagram showing the edge location amendment circuit of the optical disk recording apparatus of drawing 2 .
[Drawing 4] It is the signal waveform diagram with which explanation of actuation of the edge location amendment circuit of drawing 3 is presented.
[Drawing 5] It is the block diagram showing the rising edge amendment circuit of the optical disk recording apparatus of drawing 1 .
[Drawing 6] It is process drawing showing the creation process of the correction value table in the optical disk recording apparatus of drawing 2 .
[Drawing 7] It is the signal waveform diagram showing the regenerative signal from the pit by the quantity of light of the laser beam of 100 [%].
[Drawing 8] It is the signal waveform diagram showing the regenerative signal from the pit by the quantity of light of the laser beam of 85 [%].
[Drawing 9] It is the flow chart which shows the procedure of the computer in the process of drawing 6 .

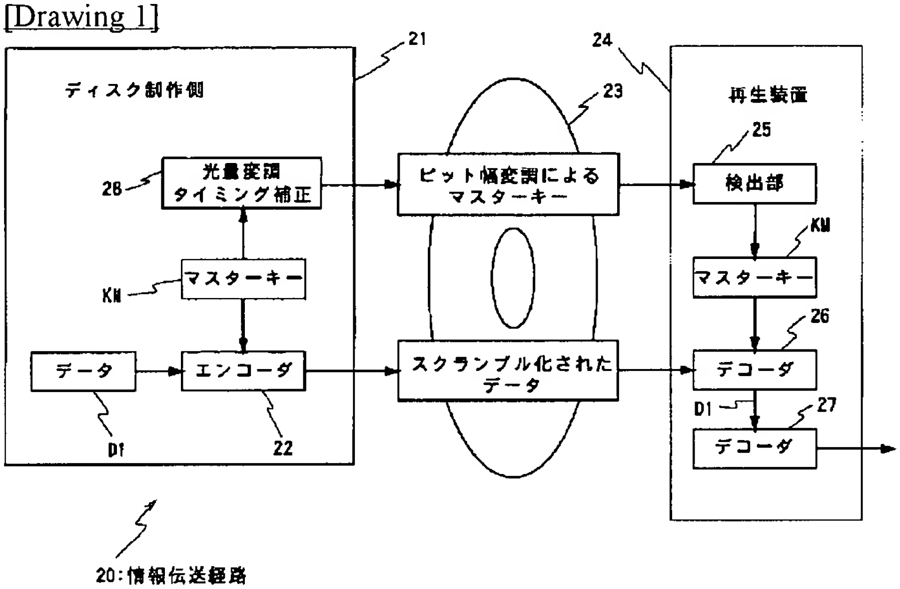
[Drawing 10] It is the block diagram showing the regenerative apparatus by the path of drawing 1 .
[Drawing 11] It is the block diagram showing the master key detector in the regenerative apparatus of drawing 10 .
[Drawing 12] It is the signal waveform diagram showing change of the slice level by difference of the quantity of light.
[Drawing 13] It is the signal waveform diagram showing the regenerative signal by the regenerative apparatus of drawing 10 by comparison with drawing 12 .
[Drawing 14] It is the block diagram showing the information-transmission path in the optical disk concerning the gestalt of operation of the 2nd of this invention.
[Drawing 15] It is the decomposition perspective view showing the optical disk concerning the gestalt of operation of the 3rd of this invention.
[Drawing 16] It is the sectional view of the optical disk of drawing 15 .
[Drawing 17] It is the block diagram showing the encoder applied to the optical disk of drawing 14 .
[Drawing 18] It is the block diagram showing the conventional anti-copying system.
[Drawing 19] It is the block diagram showing other conventional anti-copying systems.
[Description of Notations]
20,100 [.. An optical disk recording apparatus, 42A 42B / .. An edge location amendment circuit, 45 / .. A level switch circuit, 46 / .. A data selector, 54 / .. A correction value table, 79 / .. A master key detector, KM / .. A master key, KD / .. A disk key, KT / .. Title key] .... An information-transmission

path, 5, 11, 23, 63,102,102H .. An optical disk, 24, 64, 70 .. A regenerative apparatus, 30

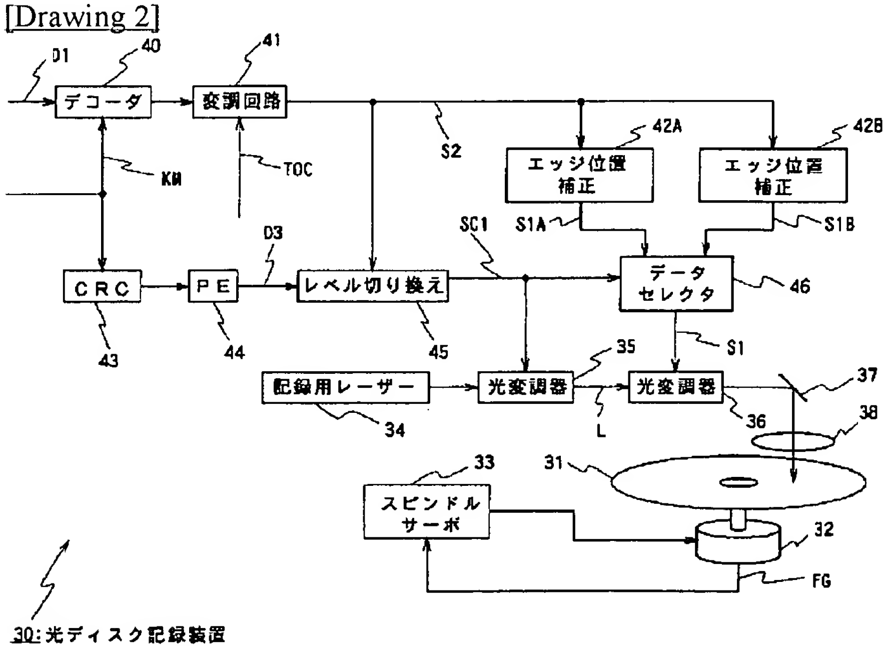
[Translation done.]

DRAWINGS

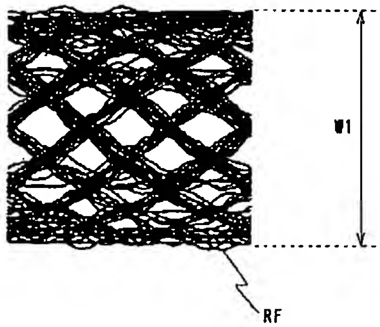
[Drawing 1]



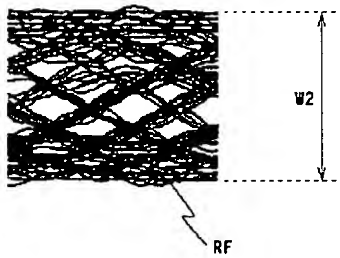
[Drawing 2]



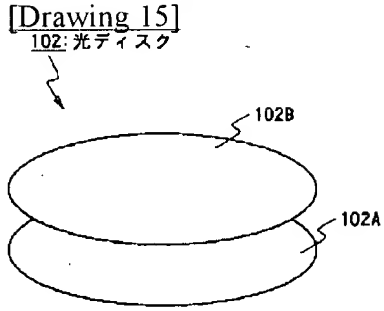
[Drawing 7]



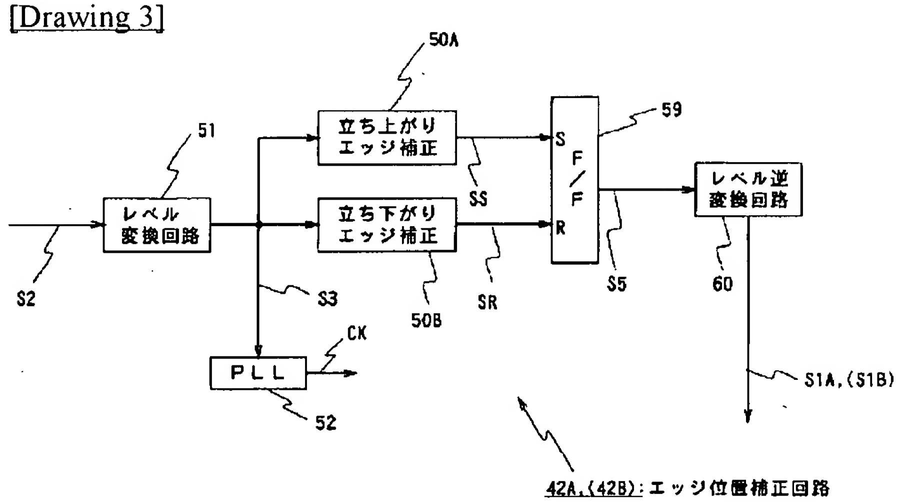
[Drawing 8]



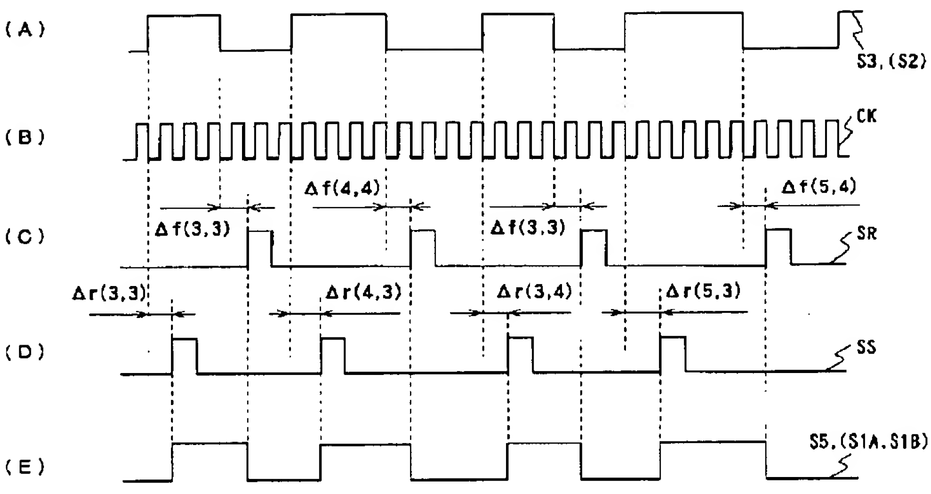
[Drawing 15]



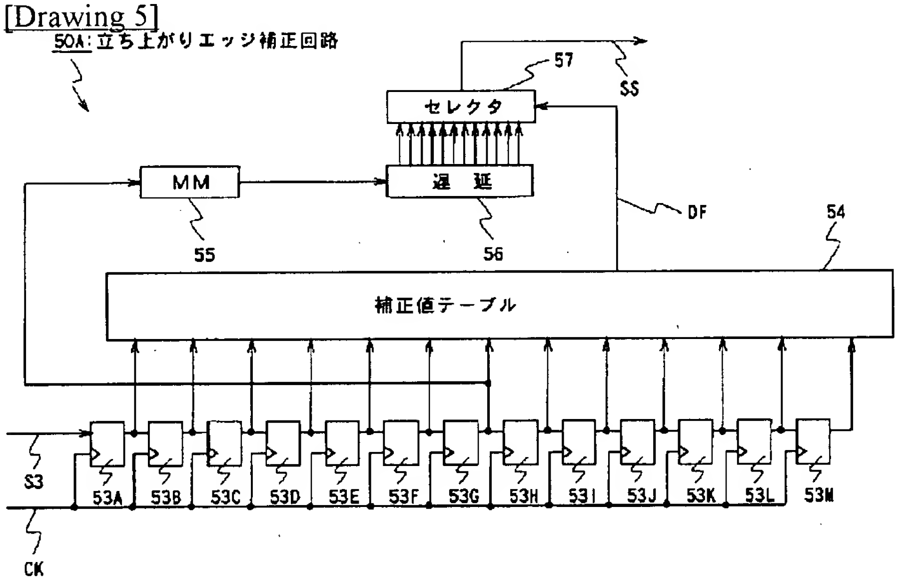
[Drawing 3]



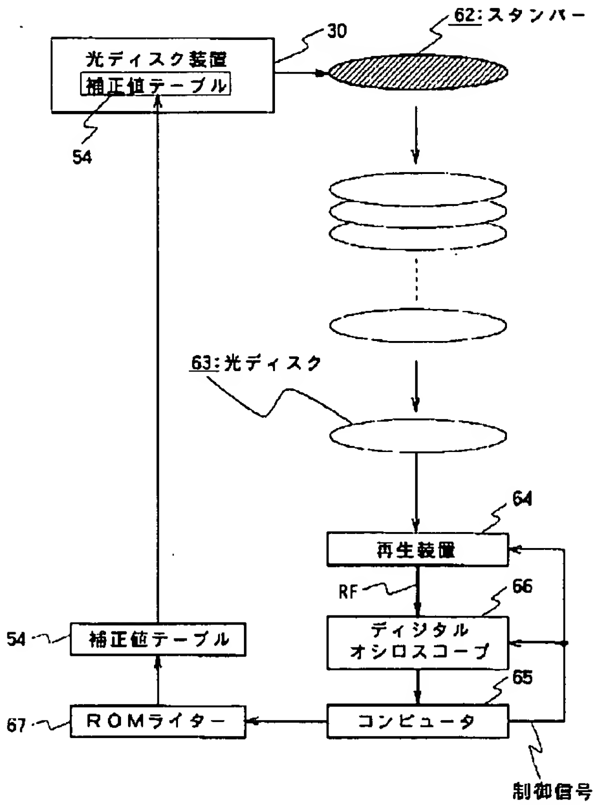
[Drawing 4]



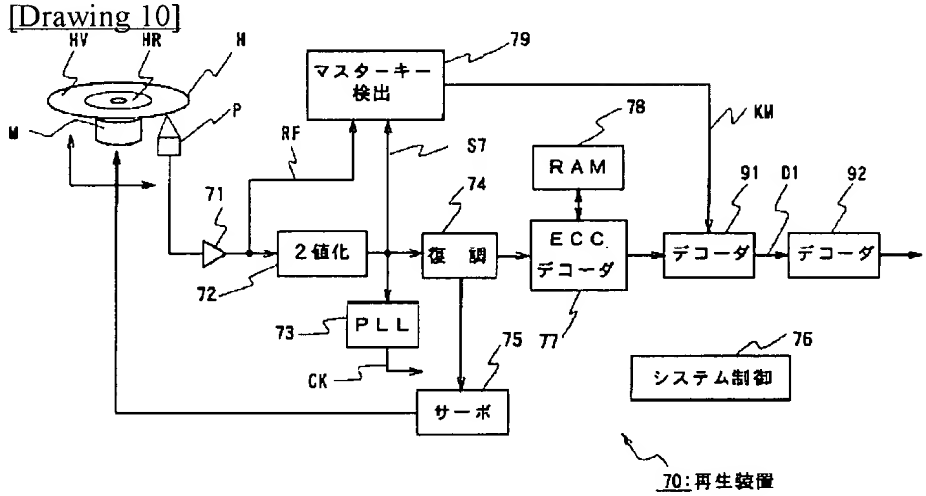
[Drawing 5]



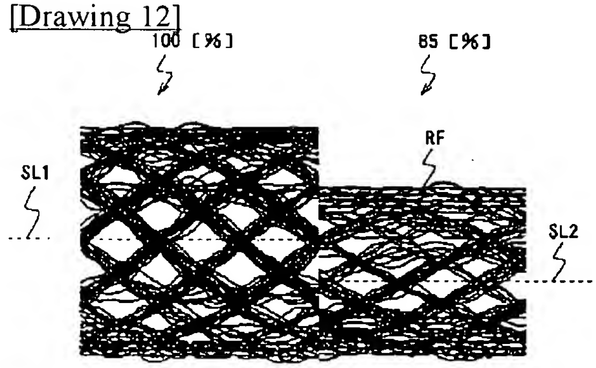
[Drawing 6]



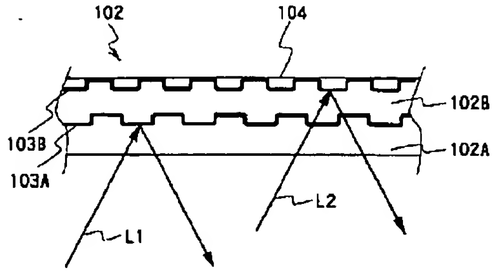
[Drawing 10]



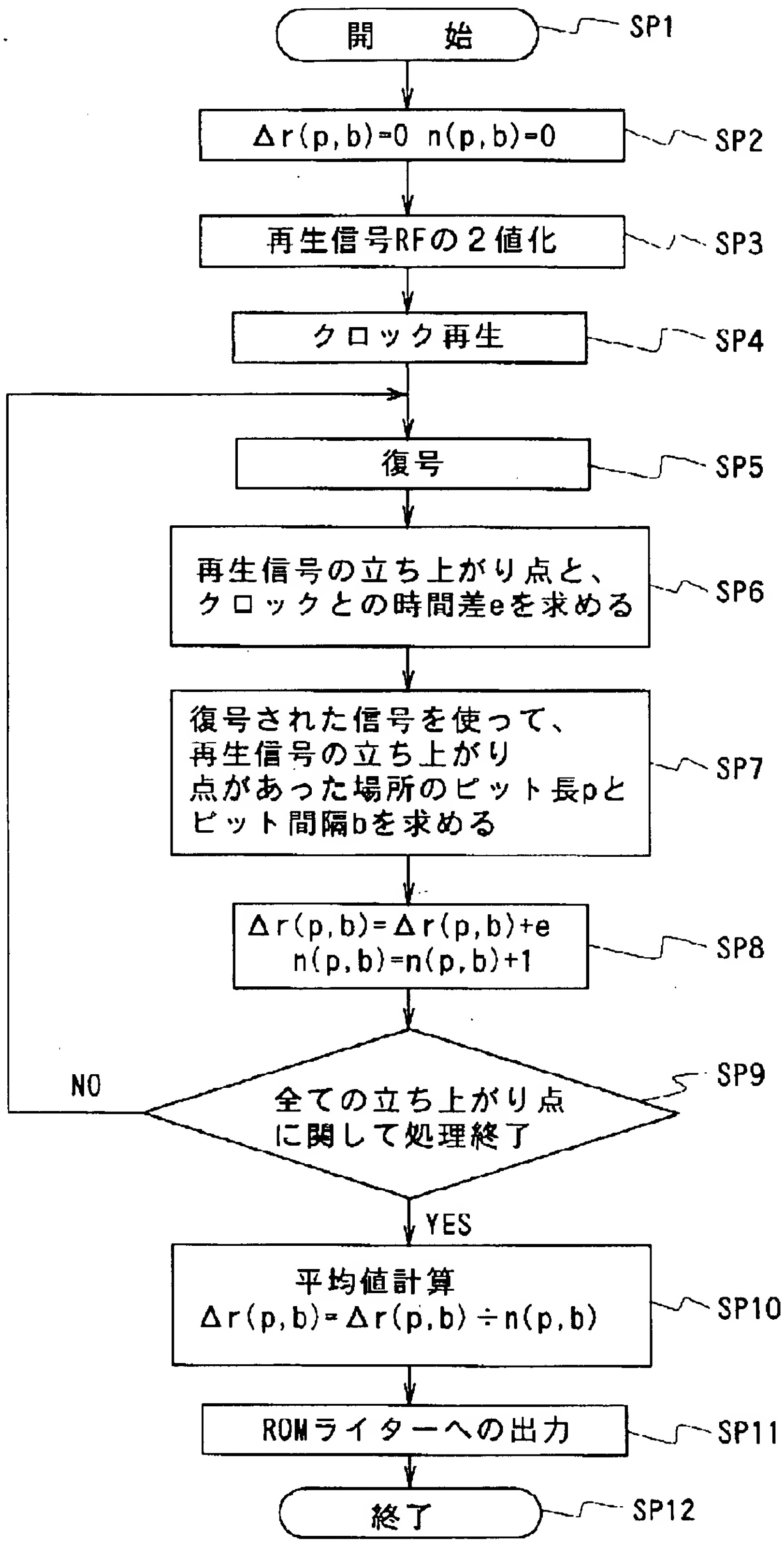
[Drawing 12]



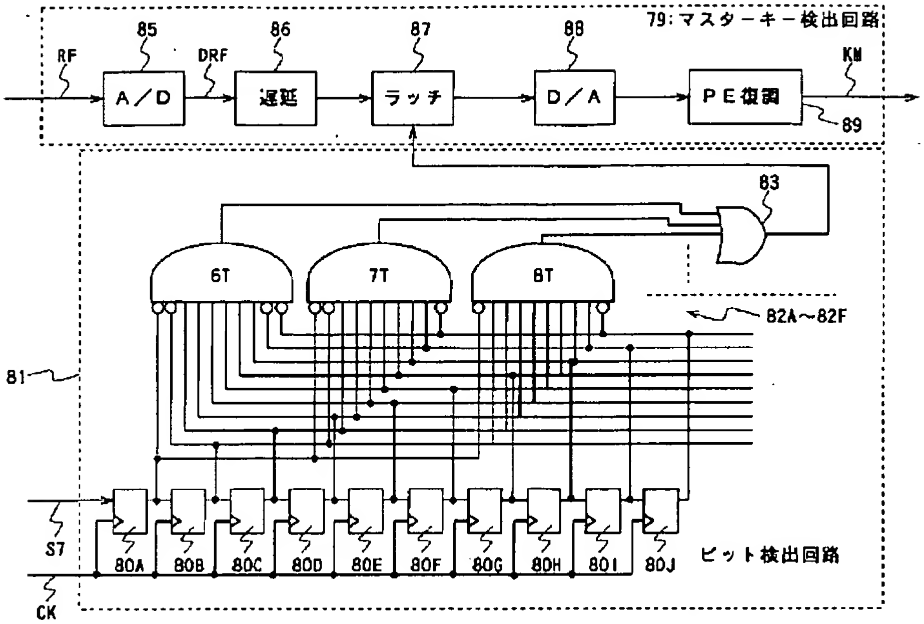
[Drawing 16]



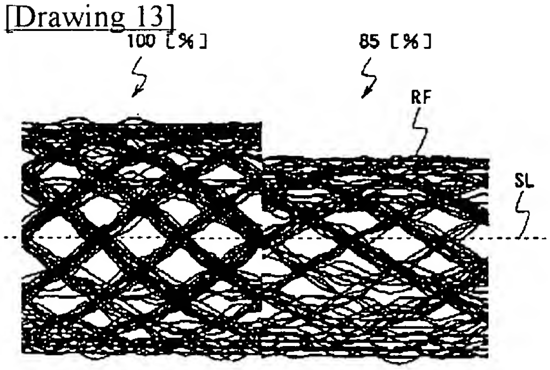
[Drawing 9]


開　始
SP1
Δr(p,b)=0 n(p,b)=0
SP2
再生信号RFの２値化
SP3
クロック再生
SP4
復号
SP5
再生信号の立ち上がり点と、クロックとの時間差eを求める
SP6
復号された信号を使って、再生信号の立ち上がり点があった場所のピット長pとピット間隔bを求める
SP7
Δr(p,b)=Δr(p,b)+e
n(p,b)=n(p,b)+1
SP8
全ての立ち上がり点に関して処理終了
SP9
NO
YES
平均値計算
Δr(p,b)=Δr(p,b)÷n(p,b)
SP10
ROMライターへの出力
SP11
終了
SP12

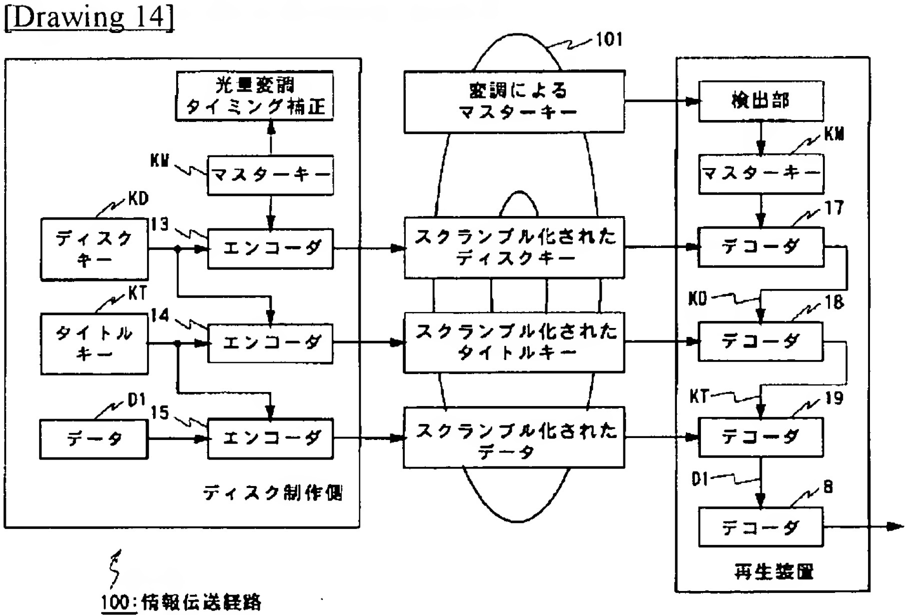
[Drawing 11]



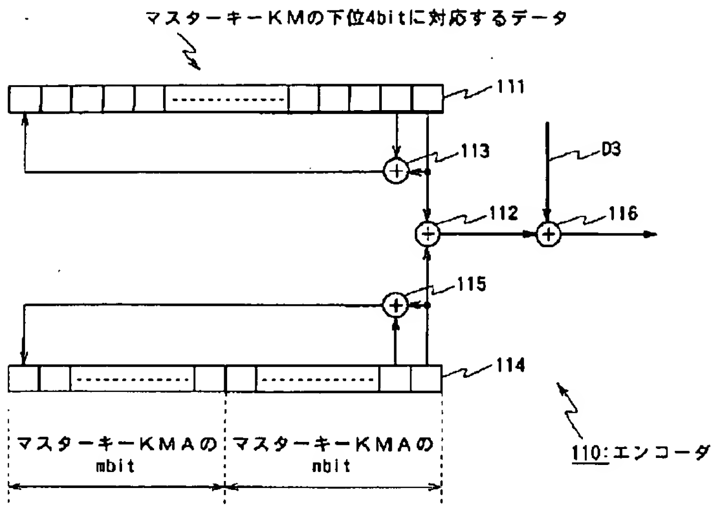
[Drawing 13]



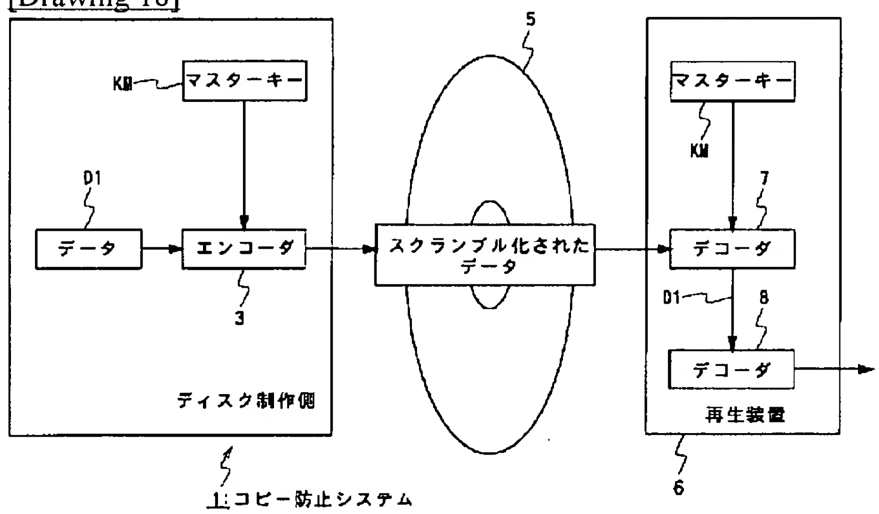
[Drawing 14]



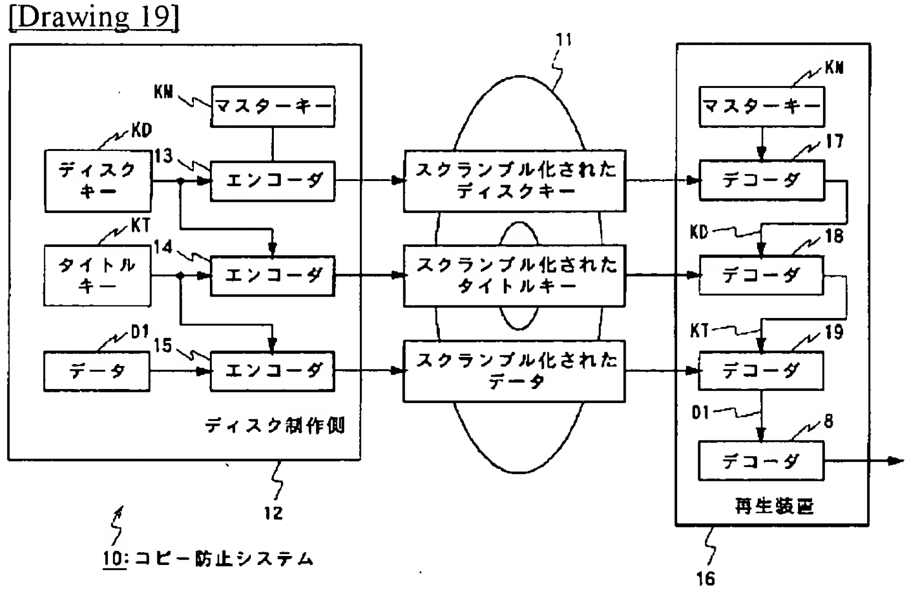
[Drawing 17]



[Drawing 18]



[Drawing 19]



[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] In the recording device which records the record data by which run length Huffman coding processing was carried out on an optical recording medium So that the jitter generated by the intersymbol interference at the time of playback may be reduced according to the change pattern detected with an edge change detection means to detect the change pattern of the edge of said record data, and said edge change detection means A timing amendment means to amend the timing of the edge of said record data, It has a light control means to control the quantity of light of the light beam which irradiates said optical recording medium based on the record data amended with said timing amendment means. The recording device characterized by controlling said light control means according to said key data while the Maine data enciphered with predetermined key data generate said record data.
[Claim 2] Said edge change detection means is a recording device according to claim 1 characterized by consisting of a rising edge detection means to amend the timing of the rising edge of said record data, and a falling edge detection means to amend the timing of the falling edge of said record data.
[Claim 3] Said timing amendment means is the recording device according to claim 1 characterized by to have the storage means which stored two or more correction-value data, and a delay means delay said record data by the predetermined time delay, and change the timing of said record data, to output correction-value data from said storage means to said delay means selectively according to the change pattern of said record data, and to set up said time delay according to said correction-value data.
[Claim 4] The recording device according to claim 2 characterized by forming the bar code pattern which spreads in a radial on said optical recording medium by controlling said light control means intermittently.
[Claim 5] It is the recording apparatus according to claim 1 which said optical recording medium has at least two information recording surfaces, and is characterized by said recording apparatus enciphering said Maine data recorded on one information recording surface based on the key data computed by the logical operation of the key data recorded on one information recording surface, and the key data recorded on the information recording surface of another side.
[Claim 6] Said optical recording medium has at least two information recording surfaces. Said recording device A preset key data generating means to generate preset key data based on some key data recorded on one information recording surface, The 1st random-number-generation means which generates the 1st random number based on the preset key data generated with said preset key data generating means, The 2nd random-number-generation means which generates the 2nd random number based on the key data recorded on one [said] information recording surface, and the key data recorded on the information recording surface of another side, The recording device according to claim 1 characterized by having the encoder which enciphers the Maine data recorded on one information recording surface based on said the 1st random number and 2nd random number.
[Claim 7] The recording device according to claim 1 characterized by performing encryption by said key data to the title of the Maine data recorded on said optical recording medium.
[Claim 8] The recording device according to claim 1 characterized by performing encryption by said key

data to the title of said ************ recorded on said optical recording medium.
[Claim 9] While the enciphered Maine data are recorded on the 1st regenerative-signal level The key data which solve said Maine data encryption are the regenerative apparatus which reproduces the optical recording medium recorded on the 2nd regenerative-signal level from which said 1st regenerative-signal level differs. A binary-ized means to make binary the regenerative signal reproduced from said optical recording medium with predetermined slice level, A key detection means to detect said key data from said regenerative signal, and a recovery means to recover said enciphered Maine data from said regenerative signal made binary, The regenerative apparatus characterized by having an encoding means by which the key data detected with said key detection means cancel the Maine data encryption to which it restored with said recovery means.
[Claim 10] A conversion means by which said key detection means changes said regenerative signal into a digital signal, A pit length detection means to detect pit length from said regenerative signal made binary, A distinction means by which the pit length which detected with said pit length detection means distinguishes whether it is more than predetermined pit length, It has a regenerative-signal level detection means to detect regenerative-signal level from said digital signal, to the pit more than the predetermined pit length which distinguished with said distinction means. The regenerative apparatus according to claim 9 characterized by detecting said key data based on said regenerative-signal level detected with said regenerative-signal level detection means.
[Claim 11] The regenerative apparatus according to claim 9 characterized by detecting said key data from the lead-in groove area of said optical recording medium.
[Claim 12] It is the regenerative apparatus according to claim 9 which said optical recording medium has at least two information recording surfaces, and is characterized by said regenerative apparatus canceling the Maine data encryption recorded on one information recording surface based on the key data computed by the logical operation based on the key data detected by one information recording surface, and the key data detected from the information recording surface of another side.
[Claim 13] The regenerative apparatus according to claim 9 characterized by performing discharge of said Maine data encryption by said key data to the title of the Maine data recorded on said optical recording medium.
[Claim 14] The regenerative apparatus according to claim 9 characterized by performing discharge of said Maine data encryption by said key data to the title of said optical recording medium recorded on said optical recording medium.
[Claim 15] The optical recording medium characterized by for key data having been recorded by the width of face of said pit, a land, a mark, or a tooth space, and recording the Maine data enciphered by the die length and spacing of said pit or a mark by said key data in the optical recording medium with which the data by which run length Huffman coding processing was carried out were formed with the gestalt of a pit and a land or a mark, and a tooth space the predetermined criteria period.
[Claim 16] Said key data are an optical recording medium according to claim 15 characterized by what was recorded on the lead-in groove area of said optical recording medium.
[Claim 17] The optical recording medium according to claim 15 characterized by performing encryption by said key data to the title of the Maine data recorded on said optical recording medium.
[Claim 18] The optical recording medium according to claim 15 characterized by performing encryption by said key data to the title of said optical recording medium recorded on said optical recording medium.

[Claim 19] The optical recording medium according to claim 15 characterized by enciphering the Maine data recorded on one information recording surface based on the key data which have at least two information recording surfaces, and were recorded on one information recording surface, and the key data calculated by the logical operation based on the key data recorded on the information recording surface of another side.
[Claim 20] The Maine data which have at least two information recording surfaces, and were recorded on one information recording surface The Maine data which are the digital audio signal which was sampled by 44.1 [kHz] and quantized in the multi-bit, and were recorded on the information recording

surface of another side The optical recording medium according to claim 15 characterized by being the digital audio signal which was sampled by 44.1[kHz] xn (n is a bigger integer than 2), and was quantized by 1 bit.

[Translation done.]